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High Voltage Experiments

By Lester Reukema

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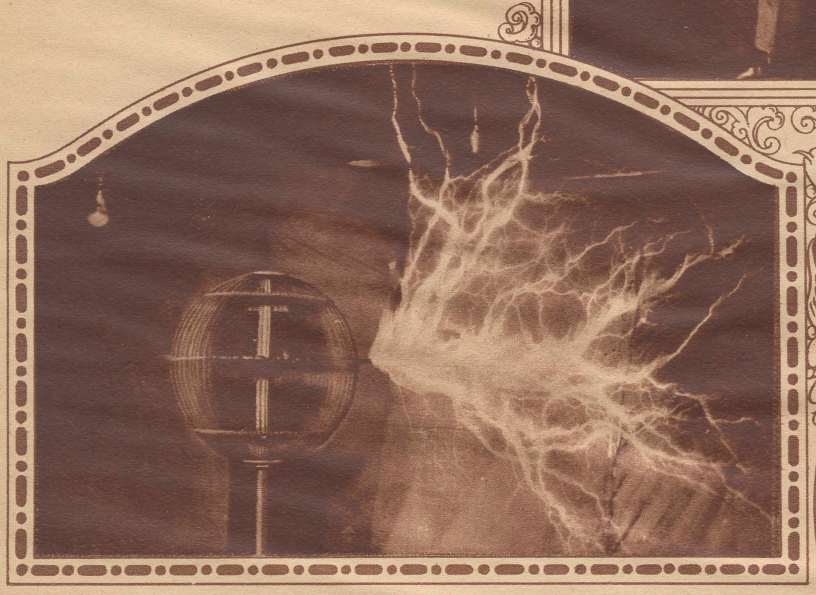
The intensity of the spark testifies to the magnitude of the current which the man in the picture at right draws from the coil. A sabre held in the hand receives the discharge from a 40 K.W. high frequency coil.



Terrifying as the discharge above appears, it can yet pass over a man's body without harm because of its extremely high frequency, which prevents its penetration into the system.

The torch bearer below stands in a basin of salt water connected to the Tesla coil. The torch is a strand of wire from which powerful sparks shoot into the air.

These concentrated sparks are the most difficult to bear, and unless the hair is thoroughly wet, it is apt to be burnt by the sparks.

IN OLDEN days, before science had, by explaining the causes of the physical phenomena surrounding us, robbed them of the mystery and awe with which earlier people invested them, the lightning was held in dread as the most spectacular demonstration of the power and majesty of the gods. Today the mystery and awe have given way to knowledge, and the electricity which manifested itself only as the dreaded lightning has been tamed and become man's most valued servant. Yet lightning still remains the most spectacular phenomenon in nature. The vivid glare flashing across the sky is a thing of most exquisite beauty; the crashing thunder echoing from every hill thrills with its suggestion of mighty power. And, indeed, although a flash of lightning consumes but a few hundred watt-hours of energy, it represents for an instant several thousand millions of kilowatts of power, since this energy is expended in a few millionths of a second.

Largely to study the destructive effects of lightning, the Tesla coil has been developed into the impulse oscillator which may be said to produce lightning artificially. Once in each year the engineering students of the University of California act as hosts to the rest of the students on the campus and to others interested in such work. And the impulse oscillator takes up its role of entertainer and producer of spectacular displays.

The discharge from the ball, as shown, is a beautiful sight, writhing tongues of violet flame shooting out from the spherical surface, branching and twisting in all directions like angry serpents. As one watches, certain of the flames succeed in hitting the walls or ceiling 10 or 11 feet away, changing instantly to dazzling white power arcs. And all of the while, the display is accompanied by a cracking, explosive roar. Thunder on a small scale. The discharge, over 11 feet in length, from the wire cage represents a potential of about 1,500,000 volts.

At this voltage the energy will tear its way through or around any kind of insulation which may be placed in its path. Wooden planks are set afire almost instantly, glass and porcelain are punctured, even marble cannot hold back the energy. It would seem as though such a bolt must mean sure and instant death to anyone so unfortunate as to be hit by it. Yet, due to the high frequency of the discharge, there is no danger whatever, if certain simple precautions are observed. Thus some pictures

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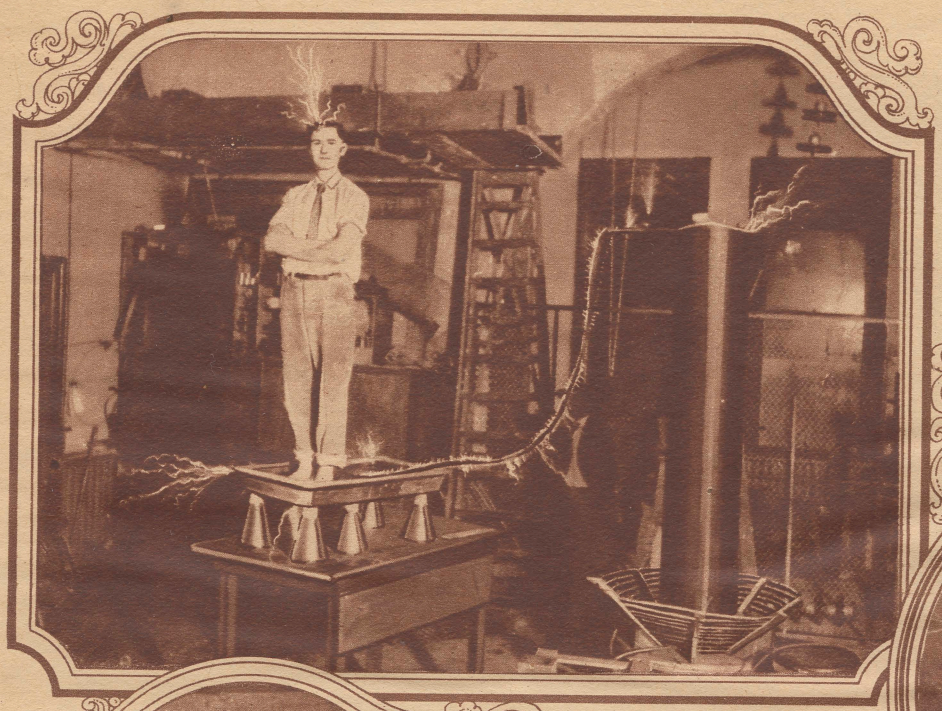
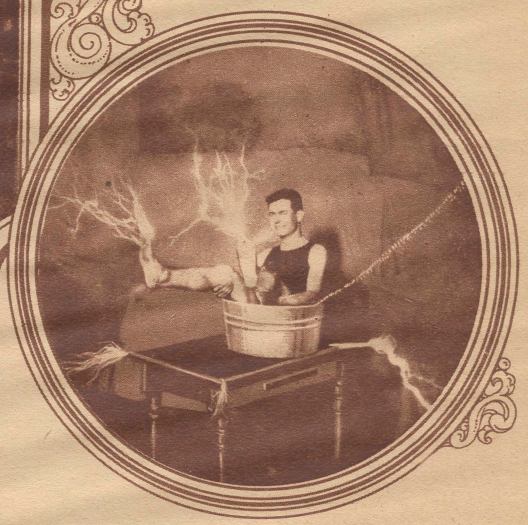
Playing with Lightning

(See also opposite page)



The man above is taking a 40 kw. high frequency discharge from the Tesla coil at the University of California. The coil used in these experiments is seven feet high. The current passes over the surface of the body only.



The gentleman above is enjoying a salt water tub bath. It is claimed by the author that no man ever got a bigger kick out of his bath than the one illustrated here.

The discharge above is radiated from a metal crown worn on the head. The use of this crown eliminates the danger of burning the hair.

The sparks emitted by the arms of the small rotor at the left impart to it a spectacular motion. The Tesla coil is connected to the salt water bath in which the man stands.

An intense high frequency current passing over the body of the man shown below, discharges at the tips of the sabre which he holds.

The terminal of the large Tesla coil in full action is shown at left. Some of the sparks are more than eight feet long.

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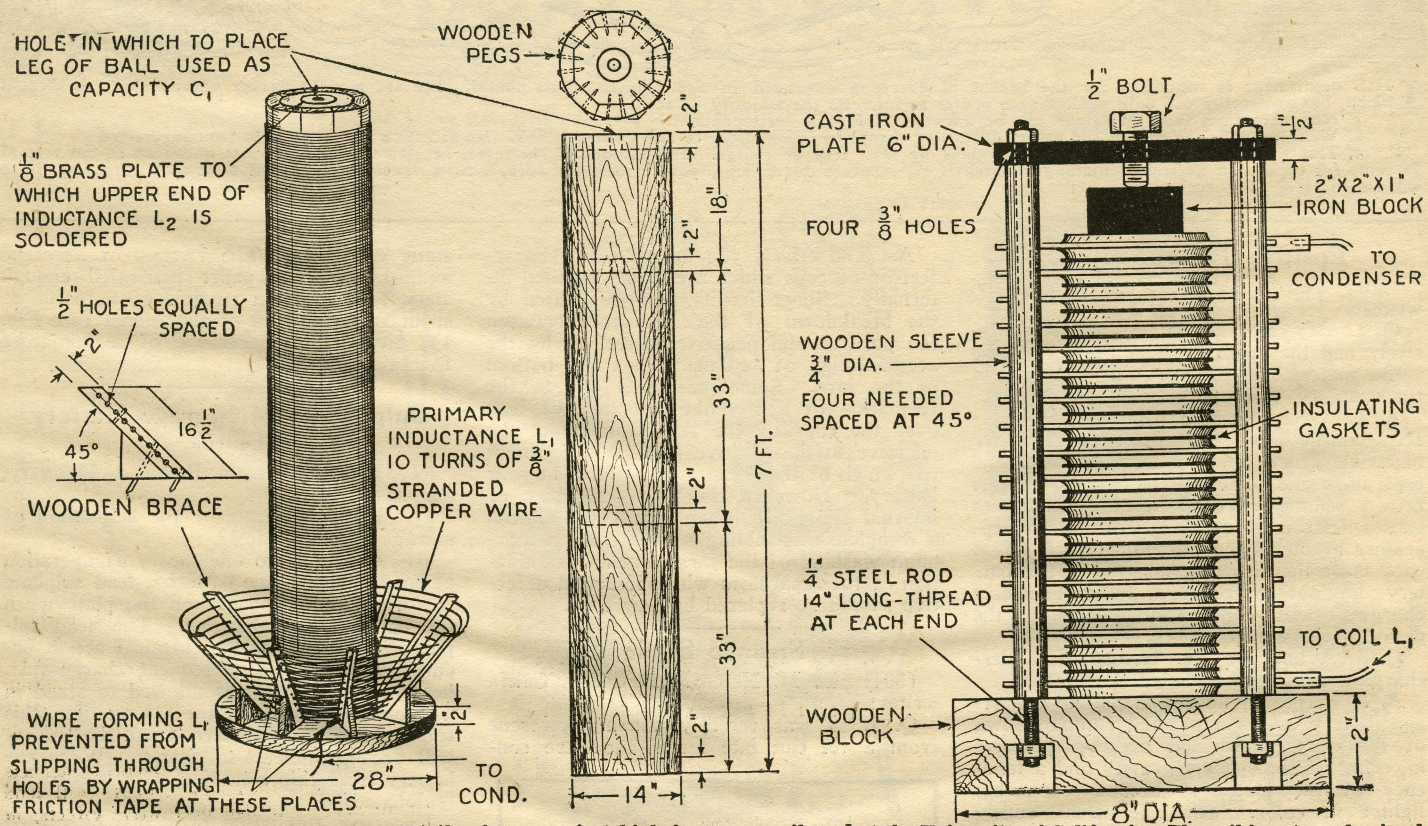


The illustrations at the left show details of a seven-foot high-frequency coil used at the University of California. The coil is extremely simple and can be constructed at very little cost by any amateur experimenter. At right is shown a very simple adjustable quenched spark gap. The details of its construction are shown on another page.

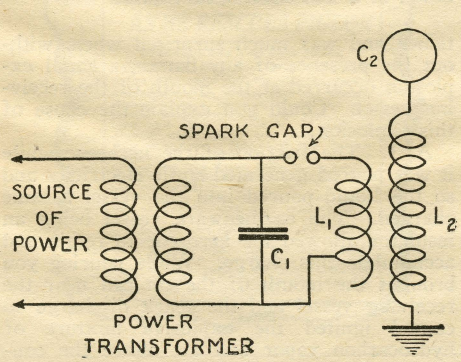
of close to a million volts into their bodies through a saber. The sensation produced by this high voltage is powerful, tensing all of the muscles of the body, but is not painful. At our show this year a large number of persons in the audience, including a six-year-old boy and about thirty young women, took the discharge into their bodies in this way.

The really spectacular part of the performance comes when the ball is removed from the top of the coil and a man substituted in its place. Since at least eight feet clearance must be allowed between the man's head and the ceiling, we place the man on a table alongside the coil, instead of on top of the coil in the position of the ball. Any method of contact would be satisfactory. We formerly fastened the man to the coil by means of a band around the arm, the band being connected to the coil. However, when large amounts of energy were being used, the current density on the arm became so great as to be painful, so that now we have substituted therefor a tub full of salt water, the tub being connected to the coil by braided wire. The salt water conducts the current from the tub to the feet, and since it comes into contact with the feet and legs over a considerable greater area than that of the arm band, it allows very much larger amounts of energy to enter the body without discomfort. The tub is insulated from the floor so as to prevent flashes to ground. We use two tables for this, one on top of the other. The large flames pouring out of the twisted wires held in the hands (Fig. 5) are a measure of the amount of energy traveling up through the body. The only reason for causing the electricity to leave this bunch of wires, instead of leaving the hands directly, is to prevent the hands being burned.

It is not necessary to hold anything in the hand to get a discharge. However, when the flames come directly from the fingers, it is necessary to wet the hand and then shake it rapidly, so as to prevent the flames from coming for more than an instant from one spot. Unless this is done, burns are sure to result.

If both hands are held close to the body the flames come from the head instead of the hands. The smile on the face of the man in Fig. 8 shows that the sensation of being charged to almost a million volts, while powerful, is not painful. Sometimes a more concentrated discharge, as, for instance, that shown in Fig. 9, sets fire to the subject's hair. Of course, a fire would always result if the hair were not kept thoroughly wet.

One way to prevent setting fire to the hair is to wear a metal crown as in Fig. 10. In this case the flames come from the points of the crown instead of from the hair.



The diagram illustrates the connection of the Tesla coil to a power transformer. A condenser C1 is constructed of a large number of milk bottles containing salt water, themselves immersed in a large pan of salt solution.

Fig. 12 shows the reason for the swimming suit seen in some of the other pictures. Here the student, sitting up to his waist in water, seems to be getting quite a kick out of his weekly bath. It is fairly certain that no man in the history of the human race ever got more of a thrill out of his tub. This picture also shows how hard it is to prevent energy from leaking out on all sides when using these high voltages. Streamers of flame are seen pouring from every corner of the table.

Some of the stunts illustrated required a strong control of the nerves, as, for instance, maintaining an intense power arc between a rod held by the man in contact with the coil and another one in the hand of a man on a nearby chair. This represents a current of several amperes on the surface and even in part through the body, and is a real test of a man's ability to stand an extraordinary powerful sensation. The sensation is not one of pain, but the inexperienced brain will usually diagnose it as such. The brain does not know how to classify it, so considers it pain, and sends a message to the arm to pull the hand away from danger. How strong a power arc a man can stand depends entirely on his mental attitude. If he is able to tell his brain that it is mistaken in its diagnosis, he can take all of the power that the apparatus is capable of giving with a smile. One stunt that always provokes applause is the pulling of sheets of flame from any place on the body of the man who is connected to the high voltage. Of course, the body must be wet to prevent burns. A favorite stunt is to wave sheets of paper within a few feet of the body, the flames which shoot out setting the paper afire.

The experiments can easily be performed by anyone at a very small cost for apparatus and without any danger whatever.